ESTO

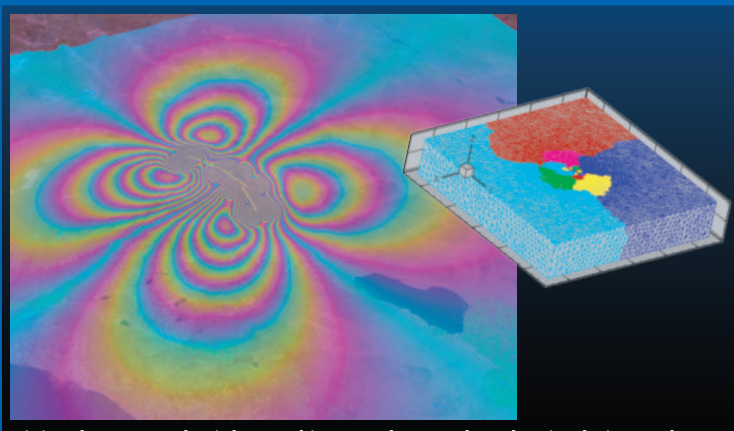
Earth-Sun System Technology Office

QUAKESIM

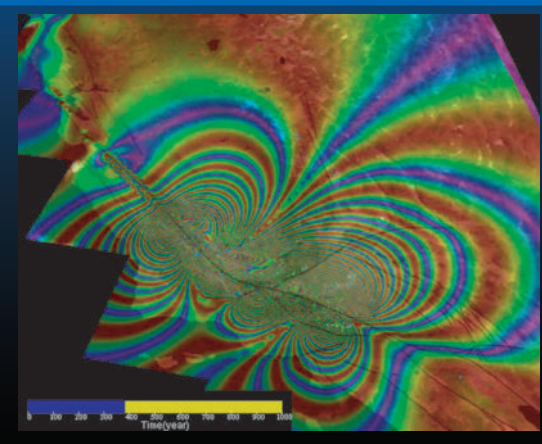
Novel space-based assets and *in situ* techniques make measurements of Earth's tectonic processes more precise and more productive than ever before. QuakeSim is a web-services based geophysical modeling environment that can enable a better understanding of these measurements, provide insights into tectonic activity, and pave the way to reliable earthquake forecasts.

How It Works

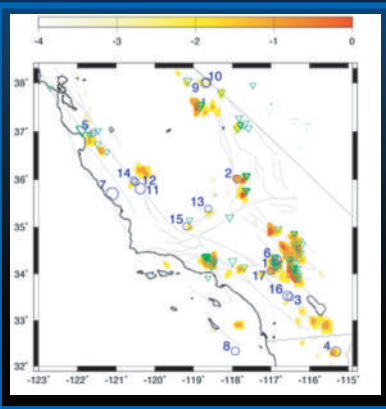
The QuakeSim portal includes a wide range of tools, including: simulation and analysis software; a federated database providing access to earthquake fault, GPS, and seismic data; and visualization tools. This portal architecture offers flexibility to expand available resources, such as the addition of data and the inclusion of new modeling codes. Three major simulation tools – Virtual California, Geophysical Finite Element Simulation Tool (GeoFEST), and PARK – are under continuing development and are available online at http://quakesim.jpl.nasa.gov.



Finite element mesh (right) used in a Landers earthquake simulation and an interferogram from a GeoFEST finite element model of the displacement during the 1992 Landers, California event.



Interferogram produced with simulated earthquake data from the Virtual California code. This image is a snapshot from a 1,000-year simulation.



Seismic hotspot map of California. The colored areas (hotspots) are found by computing the increase in potential for a large (magnitude M >5.0) earthquakes over the period January 1, 1990 - December 31, 1999. Research shows that this procedure not only locates hotspots where large earthquakes have already occurred but is also sensitive to locating large events 10 years into the future. As marked by the numbered circles, the method successfully predicted the locations of 17 large California earthquakes since January 1, 2000

Features

- A database system for handling both real and simulated data
- Fully three-dimensional finite element code (FEM) with adaptive mesh generator capable of running on workstations and supercomputers for carrying out earthquake simulations
- Inversion algorithms and assimilation codes for constraining the models and simulations with data
- A "Grid of Grids" approach to integrate databases, geophysical simulation codes, and geographical information systems using Web Services
- Visualization codes for interpretation of data and models
- Pattern recognizers capable of running on workstations and supercomputers for analyzing data and simulations

Future Applications

- As a key component of iSERVO, an international effort to develop web-based Earth science research tools, the QuakeSim portal will be integral to the development of a fully interoperable solid Earth science modeling framework
- Codes, methods, and resources developed for QuakeSim will likely be transferable to other areas of scientific inquiry

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